BOCK COMPRESSORS

Betriebsanleitung FK30
Operating instruction FK30
Instructions de service FK30
Istruzioni per l'uso FK30
Işletme kılavuzu FK30

FK30

Operating instructions

Types:

FK30/235 K	FK30/275 K	FK30/325 K
FK30/235 N	FK30/275 N	FK30/325 N
FK30/235 TK	FK30/275 TK	FK30/325 TK

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Foreword

Dear Customer,

Bock compressors are top-quality, reliable, service-friendly quality products. Please comply with the following operating and maintenance instructions so that you can benefit from all advantages to the full and use your refrigerating system throughout its entire service life. If you have any questions about installation, operation and accessories, please contact our technical service or your refrigerating system wholesale dealer or our representative. The Bock service team is available by phone under **+49 7022 9454-0**, *by e-mail under* **mail@bock.de** *or on the internet under* **www.bock.de**. *In addition, for German speaking countries we have set up a toll-free hotline under* **00 800 / 800 000 88** *from Monday to Saturday between 8 a.m. and 9 p.m. Any suggestions you may have regarding the on-going development of our compressor, equipment and parts programme are welcome at any time.*

QUALITY SYSTEM

certified by DQS according to DIN EN ISO 9001 Reg. No. 2177

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Please read the information summarised for you in this manual before starting work.

It contains important instructions for safety, installation, initial commissioning and handling. In addition you will find information on maintenance, spare parts and accessories.

Some instructions are identified by special symbols with the following meaning:

WARNING! This symbol is used to indicate that inaccurate compliance or total failure to comply with the instructions could cause injury to persons or damage to the compressor or refrigerating machine

This symbol indicates important additional instructions which you should observe during your work.

The high quality standard of Bock compressors is guaranteed also by on-going further development of machine, features and accessories. This could possibly result in nonconformities between this present manual and your compressor. Please understand that it is not possible for any claims to be derived from the details, illustrations and descriptions.

Your team at
Bock Kältemaschinen GmbH

- Subject to modifications -

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Safety instructions

The Bock refrigerating compressors named in the title are intended for installation in machines (within the EU according to EU directive 98/37/EC Machinery Directive, 97/23/EC Pressure Equipment Directive and 73/23/EC Low Voltage Directive). Initial commissioning is only allowed when the compressor has been installed according to these instructions and the whole machine in which it is integrated has been tested and accepted according to the statutory regulations.

Bock refrigerating compressors have been designed to state-of-the-art engineering. Safety for the user is given particular priority during the design stage. However, it is always possible for the refrigerating machine and operation thereof to pose unavoidable residual risks. **This is why these instructions must be observed carefully by every person working at the compressor.**

Work on the compressor may only be carried out by persons whose technical training, skills and experience together with their knowledge of pertinent regulations and documentation means that they are capable of assessing the work to be carried out and detecting any possible dangers

Safety instructions

- **Any handling of the compressor is permissible only by skilled personnel!**
- **Observe national safety regulations, accident prevention regulations, generally recognized technical rules as well as specific regulations (EN 378, EN 60204, EN 60355 etc.).**
- **Convey compressors only with hoists with sufficient lifting power.**
- **Operate compressors only in refrigeration plants with approved refrigerants.**
- **Do not exceed permissible operating pressure – even for testing purposes.**
- **Caution! Compressors are filled with protective gas ex works (approx. 3 bar nitrogen). Avoid possible injuries to skin and eyes! Wear goggles! Pressure relieve compressors before connection to the refrigeration system!**
- **Before start-up check compressor for transport damage.**
- **Before start-up check that all components installed by the user are attached correctly and connected pressure-tight with the compressor (pipes, plugs, union nuts, replaced components etc.).**
- **Before start-up evacuate the refrigeration plant with compressor carefully and then fill with refrigerant.**
- **Open pressure and suction shutoff valves before starting the compressor.**
- **Do not start the compressor in vacuum! Operate only with filled plant.**
- **Corresponding to the conditions of use, surface temperatures of more than 100 °C on the pressure side and below 0 °C on the suction side can be reached.**

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Product description

Use as intended

This operating manual describes FK30 in the standard version produced by BOCK. The vehicle compressors in series FK30 are designed for **mobile** use (other applications on request).

Short description

Three design variations are available for different areas of application:

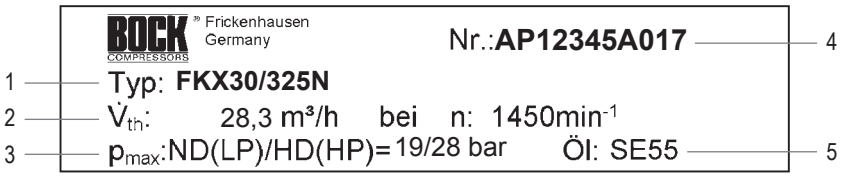
> for air conditioning the **K Design**
> for air conditioning or normal cooling the **N Design**
> for deep freezing the **TK Design**

The differences are mostly associated with the valve plate version which is adapted to each application range where operational safety and efficiency are concerned.

Additional features:

- High-performance, compact two-cylinder compressor in in-line construction
- Three output sizes
- Light-weight aluminium design
- Crankshaft mounted on either side with roller bearings
- Reduced number of sealing places due to dispensing with a base plate
- Lubrication oil pump independent of the direction of rotation, with oil relief valve
- Variable arrangement of the shut-off valves
- Ideal valve plate configuration for every working range
- Integrated pulsation damper for extremely quiet running

Nameplate (Example)



1. Type of compressor
2. Displacement at 1450 rpm
3. LP: max tol. standstill pressure intake side
   HP: max. tol. operating pressure high pressure side

} **note limits of application diagrams!**

4. Serial number
5. Oil grade filled by the manufacturer

Type key (Example)

Explanation of the type designation

[1)] K = specially for AC systems
N = for AC systems or normal refrigeration
TK = for deep freezing

[2)] X = Ester oil filling (HFC-refrigerants, e.g. R134a, R407C)

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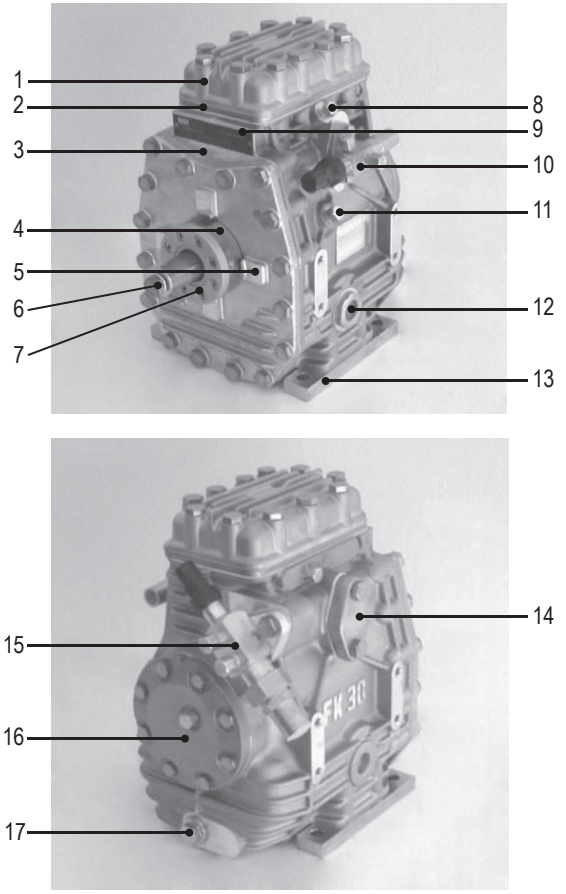
Main function parts



1. Cylinder cover
2. Valve plate
3. Compressor housing
4. Integrated leakage oil collector
5. Adapter for magnetic clutch
6. Shaft end
7. Axial face seal
8. Connection for heat protection thermostat
9. Nameplate
10. Discharge shut-off valve
11. Oil filler plug
12. Oil sight glass
13. Installation feet
14. Connection of suction shut-off valve (Optional)
15. Suction shut-off valve
16. Oilpump
17. Oil drain plug / oil filter

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Limits of application

Limits of application

Explanations

It is possible to operate the compressor within the shown diagrams. Please note the significance of the areas shaded in grey. **The application limits must be observed.** The max. discharge temperature of 140 °C and the max. ambient temperature of 100°C may not be exceeded.

Thresholds should not be selected as design or continuous operating points.

- Avoid continuous operation in the limit range. If nevertheless the compressor is used for operation in the limit range, we recommend use of a thermal protective thermostat (accessory).
- Switching frequency: The compressor should not be started more frequently then 12 times per hour, and should not run for less than 2 minutes at a time.

N- und K-version

Available models:

- FK30/235 N
- FK30/275 N
- FK30/325 N
- FK30/235 K
- FK30/275 K
- FK30/325 K

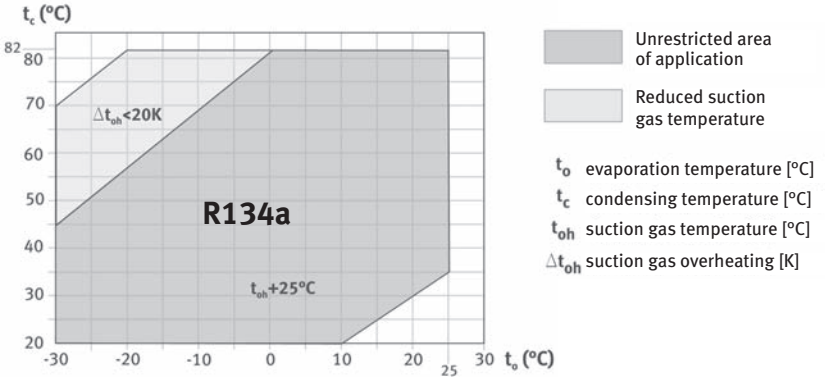
Limits of application R134a (Version N and K)

Speed range:

N-version: 500 - 3000 rpm (peak rotational speed 3500 rpm)

K-version: 500 - 3500 rpm

Max. tol. operating pressure (HP): 28 bar



Designs for other areas upon request

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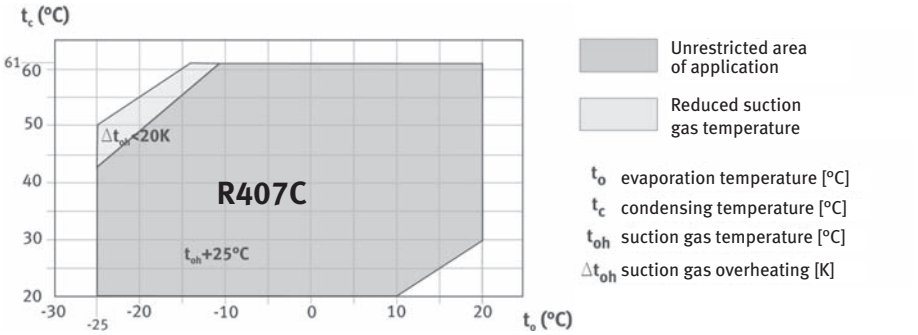
Limits of application R407C (Version N and K)

Speed range:

N-version: 500 - 2600 rpm

K-version: 500 - 3500 rpm

Max. tol. operating pressure (HP): 28 bar



TK-Version

Available models:

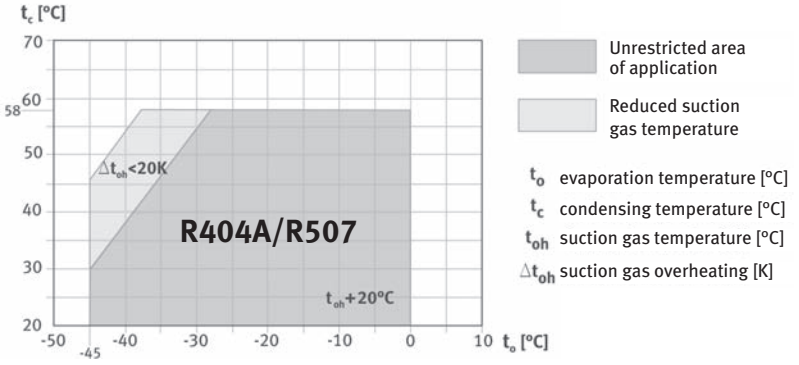
- FK30/235 TK
- FK30/275 TK
- FK30/325 TK

Limits of application R404A/R507 (TK version)

Speed range:

TK-version: 500 - 2600 rpm

Max. tol. operating pressure (HP): 28 bar



Designs for other areas upon request.

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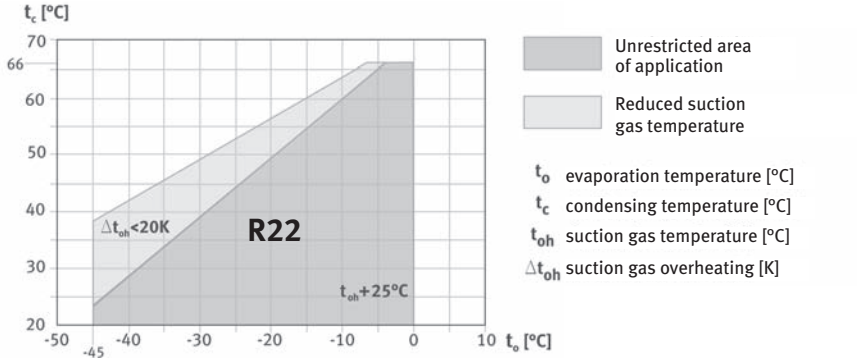
Limits of application R22 (TK version)

Speed range:

TK-version: 500 - 2600 rpm

Max. tol. operating pressure (HP): 28 bar



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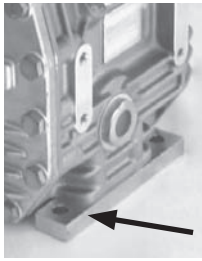
Designs for other areas upon request.

Installation

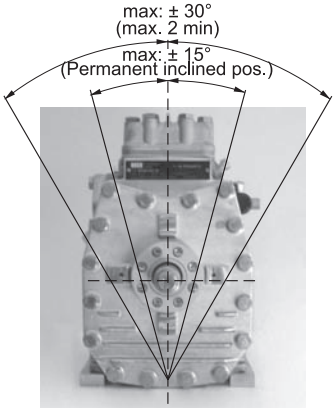
Mounting the compressor

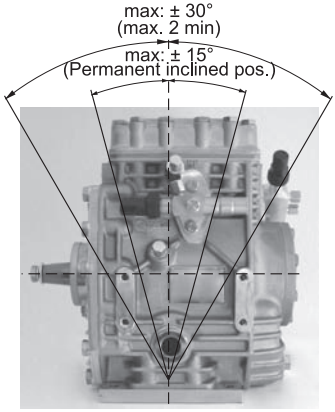
- Bock must be consulted before any other components (e.g. pipe brackets, additional appliances etc.) may be mounted to the compressor
- Proper erection of the compressor and installation of the belt drive play a major role in the running comfort, operating safety and service life of the compressor.
- In the condition on delivery the compressor is provided with installation feet (see Fig. right). Alternatively the compressor can also be bolted directly, without installation feet, on the substructure.



Warning! Compressor is under pressure!
- **Avoid injuries to skin and eyes. Wear goggles!**
- **Leave protective gas filling in the compressor up to evacuation.**
- **Absolutely avoid entry of air!**
- **Do not open shutoff valves up to evacuation.**

Inclined position





Belt drive

- Incorrectly executed belt drives, particularly belt hammers or excessive belt tension, can cause damage to the compressor!
  Please ensure that the belt drive is designed accordingly (use of tensioning pulleys, selection of belt profile and belt length, etc.)

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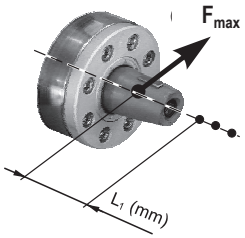
Main bearing load

The following should be observed to avoid overloading of the compressor's main bearing, e.g. by the belt drive:

- The force applied to the point of acting forces (see fig.) may not exceed F_{max} = 2750 N.
- If this point of acting force is moved forward (see fig., small dots) then the force F_{max} is diminished according to the following formula:

  $F = 245\ kNmm / (90mm + L_1\ [mm])$

Incorrectly executed belt drives, particularly belt beats due to jumping belts or excessive tensioning forces, can result in compressor damage.

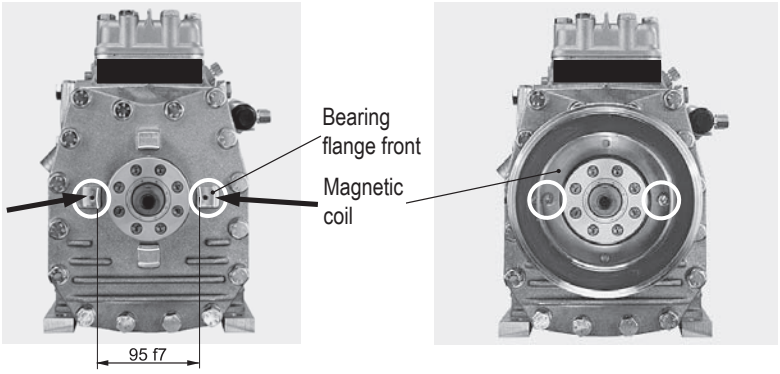


F_{max} = 2750 N
(M_{bmax} = 245 kNmm)

Installation of electromagnetic clutch

The subsequent description applies to an electromagnetic clutch type LA 30.1 made by Linnig.

- For centering and mounting the magnetic coil of clutch, the front bearing flange has a snug fit of Ø 95 f7 (see fig. left)
- For the installation push the magnetic field on snugly and fasten with 2 cheese-head screws M6 x 16 (fig right). Screw tightening torque = 15 Nm.



Continue with the installation of the electromagnetic coupling according to the instructions of the clutch manufacturer.

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Pipe connections / pipes

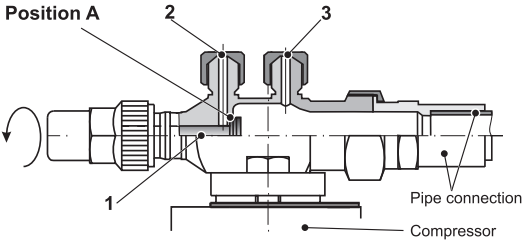
The **pipe connections** are designed in such a way that pipes of all normal metric and inch dimensions can be used. The solder connections of the shut-off should be removed during soldering.

The **pipes and unit components** should always be clean and dry on the inside, and free of cinders, metal chips, rust and phosphate coats. Furthermore the parts, including the hoses, must be delivered sealed air-tight.

Shut-off valves

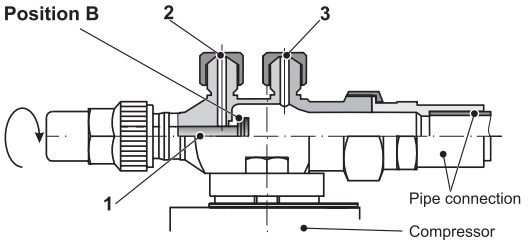
Opening the shut-off valves

a) Open spindle 1: to the left (anti-clockwise) as far as it will go. → Shut-off valve fully opened / service connection 2 closed (setting A),fig.

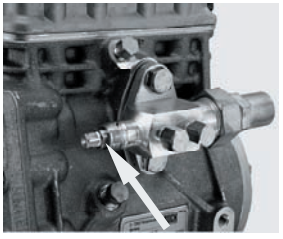


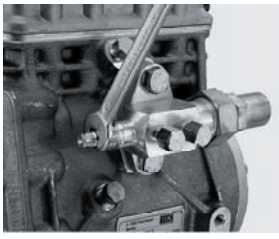
Opening the service connection (2)

b) Turn spindle 1: 1/2 - 1 turn to the right (clockwise). → Service connection 2 opened / shut off valve open (setting B), fig. Connection 3 is for safety purposes and not lockable.



Note: Before opening or closing the shut-off valve, loosen the valve spindle seal (fig. left) 1/4 of a turn. Tighten the valve spindle seal again carefully after activating the shut-off valve (fig. right).





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Initial commissioning

Putting into operation

The compressor has undergone trials in the factory and all functions have been tested. There are therefore no special running-in instructions.

Caution! To protect the compressor from intolerable operating pressures, high- and low-pressure pressure gauges are necessary. Please comply with the accident prevention regulations!

Leak test, evacuation

- Check the cooling system for leaks without including the compressor (preferably with dried nitrogen (N_2).
- In the following evacuation procedure, evacuate the system first, then include the compressor in the evacuation procedure:
  - Release pressure in the compressor.
  - Open the suction and discharge shut-off valves.
  - Evacuate the suction and high-pressure side with the vacuum pump. Vacuum < 1.5 mbar with pump switched off.
  - Repeat procedure several times.

Refrigerant filling

- Check whether the compressor suction and discharge shut-off valves are open.
- With the compressor switched off, fill in liquid refrigerant into the system (breaking the vacuum) straight into the receiver.
- Start operation of the compressor. If the refrigerant needs topping up after starting the compressor, it can be topped up in vapor form on the suction side.
- **Do not fill liquid refrigerant into the suction shut-off valve on the compressor.**
- **Do not mix additives with the oil or refrigerant.**

Oil level check

Immediately after starting, check the oil level of the compressor.

- Drive motor in operating mode “high idle” (high idle speed).
- The compressor should run for min.10 minutes.
- The machine should have reached the operating points.
- Check oil level: the oil level must be visible in the sight glass.
- After the exchange of a compressor the oil level must be controlled again. When the oil level is too high oil must be discharged (danger of oil impacts, less performance of the air conditioning system).

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Tightness of the shaft seal

The tightness of the compressor shaft is obtained by an axial face seal (see page 6, fig., item 7). This seal rotates with the compressor shaft.
The following points are **particularly important** for its proper operation:

- The entire cooling circuit has to be **expertly built** and its interior must be clean.
- Violent shocks or vibrations on the shaft, as well as **intermittent operation for longer periods have to be avoided.**
- During longer standstill periods (e.g. in the winter), it is possible for the sealing surfaces to stick together. For this reason, **the machine should be started up for 10 minutes about every four weeks.**
  Disregard of these directives may cause loss of refrigerant or damage the axial face seal.
- **The axial face seal ensures tightness thanks to the lubricating oil. Small oil losses (a few drops) are thus normal. This is particularly true during the run-in period (200 - 300 h).**
- **In order to retain the leakage oil as long as possible the FK 30 is fitted with an integrated leakage oil collector (see. page 6, fig., item 4). It collects the leakage oil, and the oil generally evaporates without leaving any visible trace.**

Replacement of the axial face seal

As the replacement of the shaft seal requires opening of the refrigerant circuit, it is only recommended if the compressor is really loosing refrigerant. If an oil leakage occurs above the leakage oil collector, we recommend replacement only of the collector ring, which is provided with felt on its inside (fig.). The collector is available as a spare part (see table, page 15). The replacement of the sliding ring seal is described in the note accompanying each spare part kit.

Liquid operation

Liquid operation can damage the compressor and cause leakage of refrigerant.
In order to avoid liquid operation the following points should be **carefully observed:**

- The complete refrigerating plant must be **properly rated and executed.**
- All components of the installation must be **matched to each other in their performance characteristics** (particularly evaporator and expansion valve).
- The suction gas superheat at the outlet of the evaporator should be **at least 7 to 10K** (check the setting of the expansion valve).
- Machine must reach steady state condition.
- Especially on critical installations, having for example several evaporation points, it is recommended that appropriate measures be taken, such as the use of liquid traps, solenoid valves in the liquid lines etc.

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Maintenance

Safety instructions

Before starting any work on the compressor:

- **Switch off the compressor and secure to prevent unintentional switching on.**
- **Relieve pressure in the compressor.**

After completed maintenance:

- **Connect the safety switch.**
- **Evacuate the compressor.**
- **De-activate the switch-on safeguard.**

Service-intervals

To guarantee optimum safety and service life for the compressor, **we recommend** that the following servicing activities and checks be carried out at regular intervals (particularly recommended when the machine is used in the limit range at high temperature and pressure conditions):

- Oil change: Basically it is not vital for the oil to be changed in machines which have been manufactured and are operated correctly. But on the basis of our decades of experience, we recommend the following oil change services:
  - first oil change when servicing the vehicle for the first time
  - then every 5,000 operating hours or at the latest after 3 years,whichever happens first, cleaning the oil filter and the filter intake side at the same time. If necessary, replace the oil felt of the shaft seal.
- **Function tests**: **Once per year**, oil level, compressor leak test, operating noise, pressure, temperatures, correct functioning of additional components e.g. capacity regulation.

Recommended spare parts (Pleasa use original Bock spare parts exclusively)

	FK 30/235 N + TK	FK 30/275 N + TK	FK 30/325 N + TK	FK 30/235 K FK 30/275 K FK 30/325 K
Designation	Art.-No.	Art.-No.	Art.-No.	Art.-No.
Valve plate kit	80240	80242	80241	80010
Set of gaskets		80232		80126
Set of shaft seals		80123		
Oil collector ring		80127		

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Integrated overcurrent safety valve:

The valve requires no maintenance.

However, abnormal operating conditions can result in constant leaks after blowing off. This can lead to reduced output and increased compressed gas temperature. Check the valve and replace if necessary.

Screwed unions

Various installation, maintenance and servicing work entails intervention in the compressor. All work must therefore be performed with strict compliance with the given safety instructions. The following torques must be used when re-assembling the compressor

Cylinder cover	M10	60 Nm
Axial face cover	M6	15 Nm
Connecting rod	M6	15 Nm
Oil drain screw	M22 x1,5[1)]	100 Nm
Oil filler plug	1/4“ NPTF	25 Nm
Soldered connection	1 1/4“-12 UNF	110 Nm
Shut-off valve	M8/M10	37 Nm/60 Nm
Electromagnetic clutch	M12	85 Nm
Safety valve	M24 x 1,5	100 Nm

[1)] Screw with aluminium seal

Notes: Cylinder head/valve plate: tighten screws from the middle outwards crosswise in at least two stages (torque 50/100%).

Excerpt from the lubricant table

The oil type filled in the compressor as a standard in the factory is indicated on the **name-plate**. **This oil type should be given preference**, other oil types are listed in the following excerpt from our lubricant table.

Lubricants

Bock standard oil grade	Recommended alternatives	
for H-CFCs (e.g. R22)		
FUCHS Reniso SP 46	MOBIL SHC 425 SHELL Clavus SD 22-12 SUNOIL Suniso 3 GS	SUNOIL Suniso 4 GS TEXACO Capella WF 46
for fluorocarbons (e.g. R 134a, R404A, R407C)		
FUCHS Reniso Triton SE 55	FUCHS SEZ 32 / 68 / 80 ICI Emkarate RL 46 S	MOBIL Arctic EAL 46 SHELL Clavus R 46

Information about other suitable supplementary or substitute oils is available in the Bock lubricant tables.

Caution! The oils are to be checked for suitability according to the operating conditions and refigerants.

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Decommissioning

For major repairs or when decommissioning:

Comply with the safety instructions on page 15! Close the shut-off valve on the compressor, vacuum out the refrigerant (do not blow out!) and dispose of correctly. Open the screwed unions or flanges at the compressor valves and remove the compressor using hoisting gear if necessary. When scrapping the compressor, drain the oil and dispose of correctly. Comply with the national regulations!

WARNING! Compressor is under pressure! Avoid injures to skin and eyes. Wear goggles!

Accessoires

Heat protection thermostat
(Special accessory - can also be retrofitted, Art. No. 07595)

On the hot gas side of the compressor housing there is a connection for the sensor element (fig. page 6, item 8). The heat protection thermostat is to be connected in series with the control line.

Technical specifications:

Switching voltage max.:		24 V DC
Switching current max.:		2.5 A at 24 V DC
Cut off temperature	:	145°C ± 5 K
Cut on temperature	:	approx. 115°C

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Technical data, connections

Technical data

Type	Nr. of cyl.	Swept volume	displacement (1450 rpm)	Weight	Connections		Oil filling
					Discharge side HP	Suction side LP	
		cm^3	m^3/h	kg	mm / Inch	mm/Inch	Ltr.
FK30/235	2	235	20,3	25,0	16 / $^5/_8$	22 / $^7/_8$	2,0
FK30/275		275	24,1		22 / $^7/_8$	28 / 1 $^1/_8$	2,0
FK30/325		325	28,3		22 / $^7/_8$	28 / 1 $^1/_8$	2,0

Inertia moment of the driving unit [kgm^2]: 0,0028
Lubrication: Forced lubrication
Oil pump: independent of sense of rotation

Connections

A	Connection suction side, not lockable	7/16“ UNF
A1	Connection suction side, lockable	7/16“ UNF
A2	Connection suction side, not lockable	1/8“ NPTF
B	Connection discharge side, not lockable	7/16“ UNF
B1	Connection discharge side, lockable	7/16“ UNF
C	Connection oil pressure switch OIL	1/8“ NPTF
D	Connection oil pressure switch LP	1/4“ NPTF
E	Oil pressure gauge connection	1/8“ NPTF
F	Oil drain	M22 x 1.5
G	Opt. connection for oil sump heater[1)]	-
H	Oil charge plug	1/4“ NPTF
K	Sight glass	1 1/8“-18 UNEF
L	Connection thermal protection thermostat	1/8“ NPTF
M	Oil filter	M22 x 1.5
SV1	Optional position of connection for suction line valve	-

* L = Soldering connection
[1)] = Only possible ex factory

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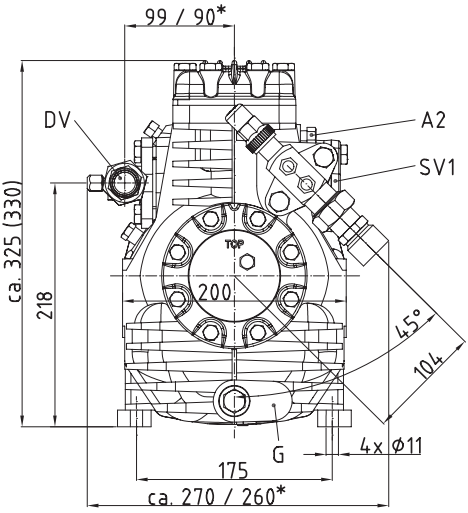
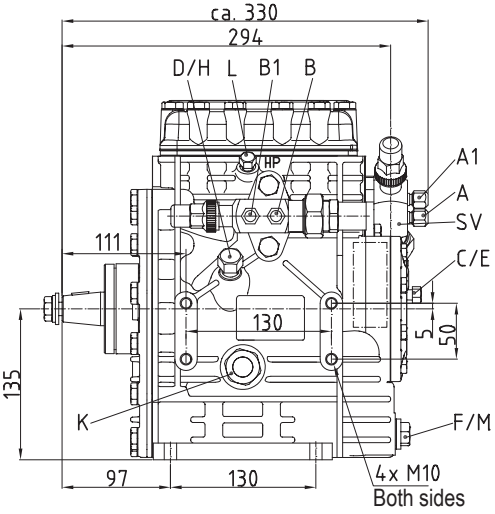
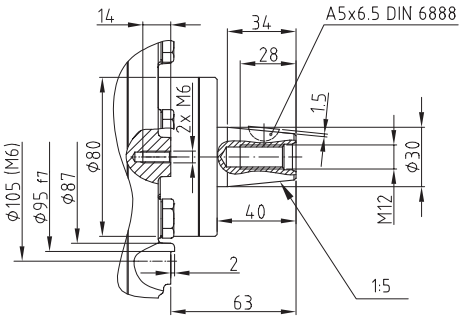
Dimensions



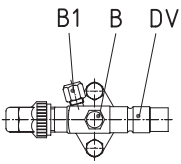


( )= Only on K Version

*= FK30/235 cm³



only FK 30/235



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MANUFACTURER DECLARATION
for use of the compressors within the European Union
(refering to the EU machinery directive 98/37/EEC, annex II B)

We herewith declare that the refrigerating compressors named in the title in the version supplied by us are intended for installation in a machine which complies with the machinery directive 98/37/EEC.

Applied harmonised standards

EN ISO 12100-1	EN 349	EN 60529
EN ISO 12100-2	EN 60204-1	

It is however not permitted to start up our products before the machine in which they are integrated has been tested according to the corresponding statutory regulations and declared to be conforming in all points.

Frickenhausen, 17.05.2004

Dr. Harald Kaiser
Technical Director

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Subject to change without notice